Our Presenter Today

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Stefan Thöne is an application engineer focusing on optical engineering at Ansys.

He has +7 years of experience working in lighting design, consulting and training.

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Generate a Digital twin from Material Properties

Ansys

Agenda

- Introduction to Optical Simulation using Speos
- Generating A Digital Twin using Optical Simulation
  - Material Modell
  - Define Comon usecase
  - Verify Model using Measurement and Simulation
  - Generate Digital Twin based on Production parameter
  - The Digital twin
  - Verify Digital twin using simulation

Ansys Speos Software

Challenges in optics

Optical technologies

are **integral** to many current designs for **products and infrastructures**, such as cars, planes, cities, buildings, etc.

. Today, there is **much emerging** for optical systems, and players need **the best tools and processes** to keep up with the **growth and challenges the industry** is facing.

- Time to market
- Lit appearance
- Visibility and legibility
- Regulation compliance
- Perceived quality
- Reflection issues
- Lighting comfort

Optics in automotive

- ✓ Safety
- ✓ Ergonomics
- ✓ Perceived Quality


ADAS / AD


Exterior Lighting


Interior Lighting


HMI

AR - HUD


Colors & Materials

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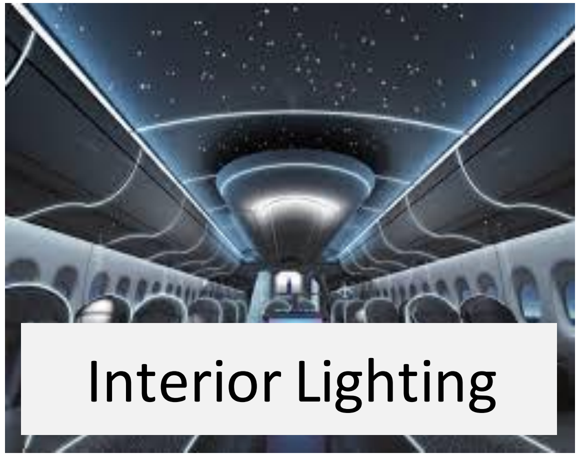
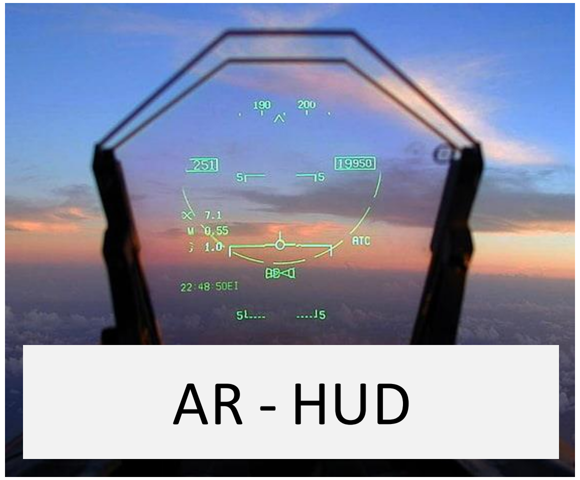
Optics in aerospace and defense

- ✓ Safety
- ✓ Ergonomics
- ✓ Perceived Quality





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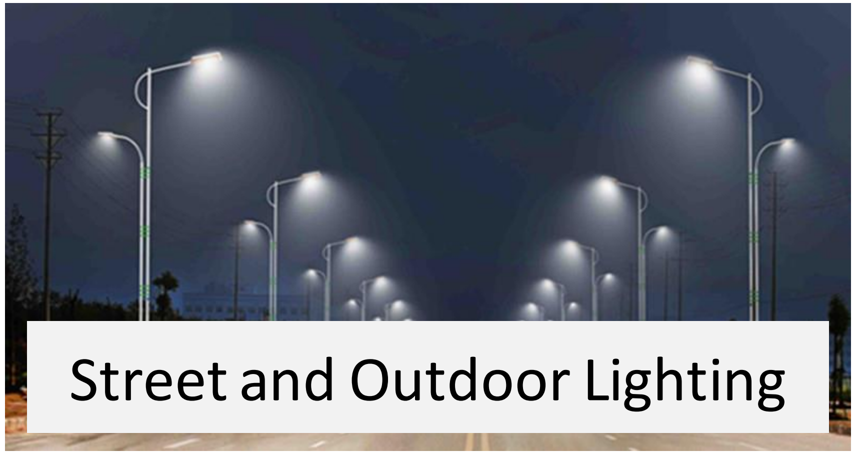
Optics in lighting

- ✓ Safety
- ✓ Ergonomics
- ✓ Perceived Quality



Ansys SPEOS

Core Capabilities

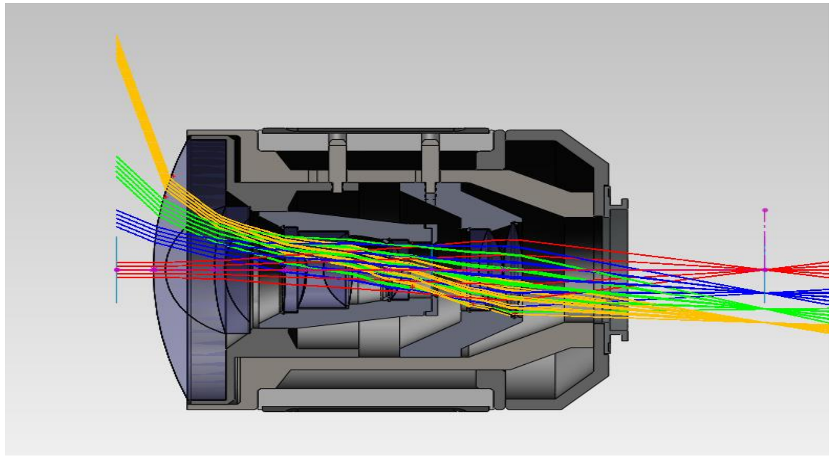
Lighting system performance

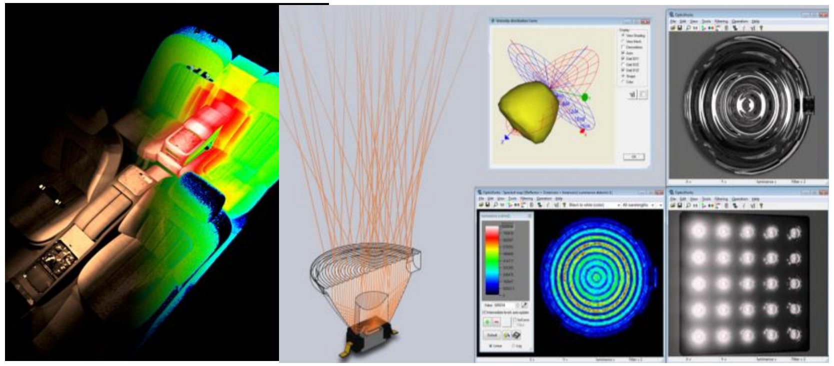
Pro | Premium | Enterprise

Model the luminous flux and perform physically correct colorimetry and photometry studies to validate materials and light sources.

Explore **intuitively light propagation** and get an in-depth understanding to improve the **performance** of lighting systems

Analyze with **industry-oriented** tools to ensure **compliance with regulations and requirements**





Optical design optimization

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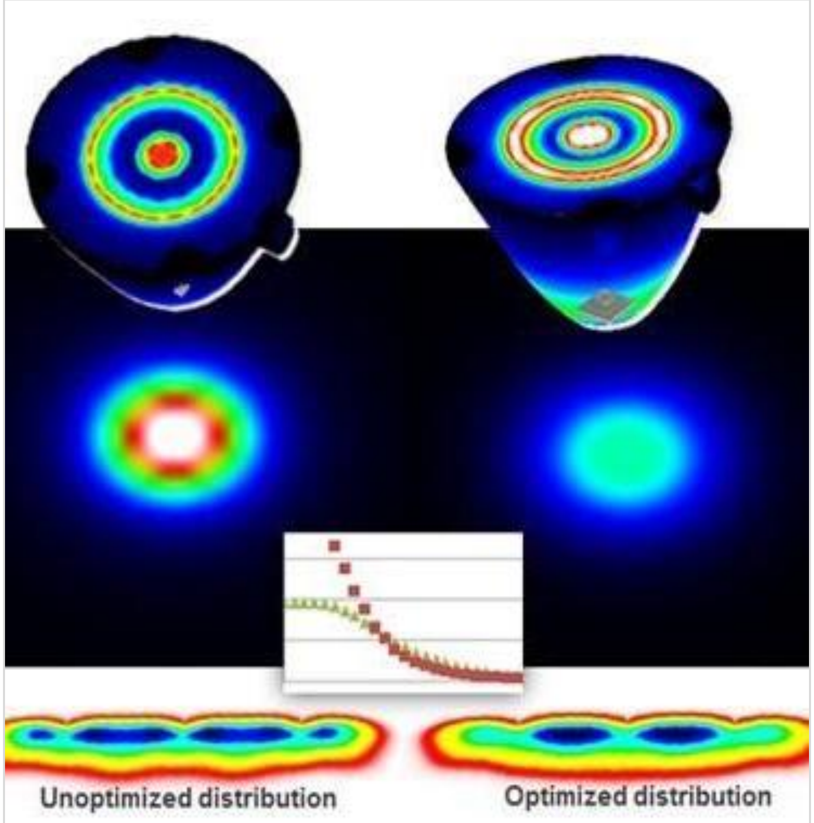
Bridge the gap between optics and CAD by automatically optimizing optical performance

- Determine both optimal **mechanical** and **optical** design parameters
- Shorten engineering development by increasing engineer **productivity**
- Process **tolerance** studies of optomechanical systems

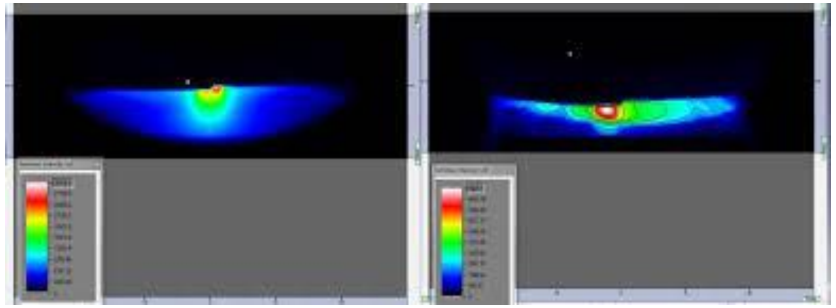


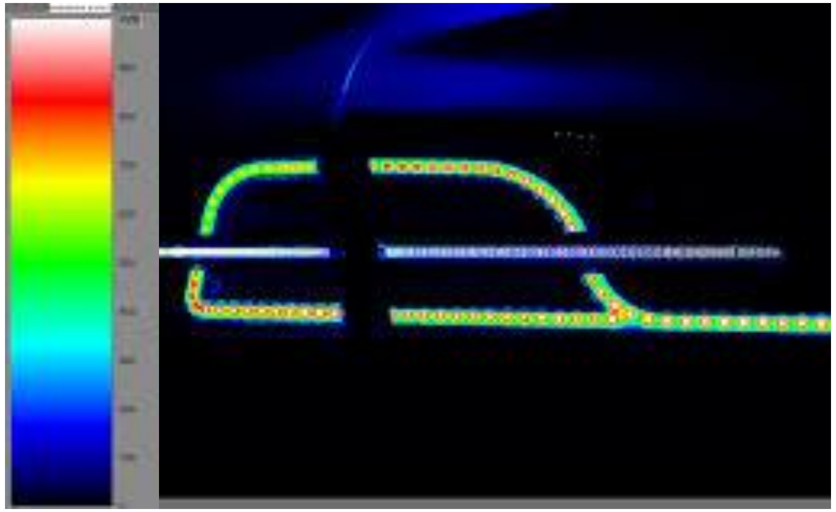
Advanced optical analysis

Pro | Premium | Enterprise

Conduct advanced analyses of the performance and appearance of lighting systems

- Advanced analytics for photometry, radiometry, spectral intensity, illuminance and luminance
- Colorimetry measurements and studies to validate your choice of materials
- Validate systems against design requirements and check compliance with industry or legal specific standards





User material editor: mie feature

Or how to model emulsions

What is mie feature for?

- **Pre-processing that model materials**
- For emulsions materials (i.e. volume material composed of many particles)

- Particles prerequisites:
  - Spherical
  - Pure (i.e. made of a single material : water, air, polysterene,...)
  - Diluted (i.e. particles are far from each other)

- Mie feature in Speos automatically computes the exact mean Volume Optical Properties **usings wave optics laws.**
  - $\mu_{abs}(\lambda)$ Absorption coefficient
  - $\mu_{scatt}(\lambda)$ Scattering coefficient
  - $f_{scatt}(\theta, \phi, \lambda)$ phase function

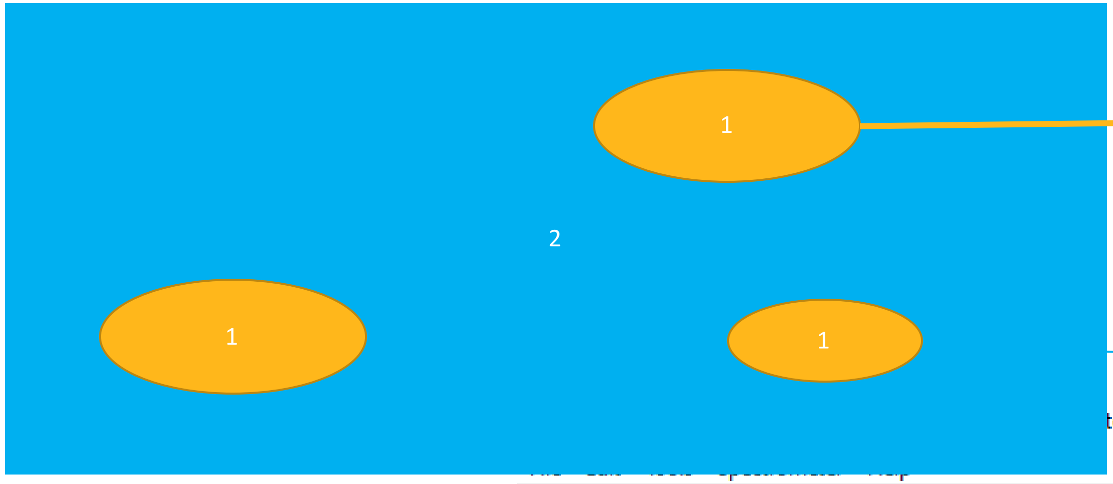
- To define A Model in Mie Theorie follwin
  - Refractive indices of Particles & host medium
  - Quantity of particles with their size

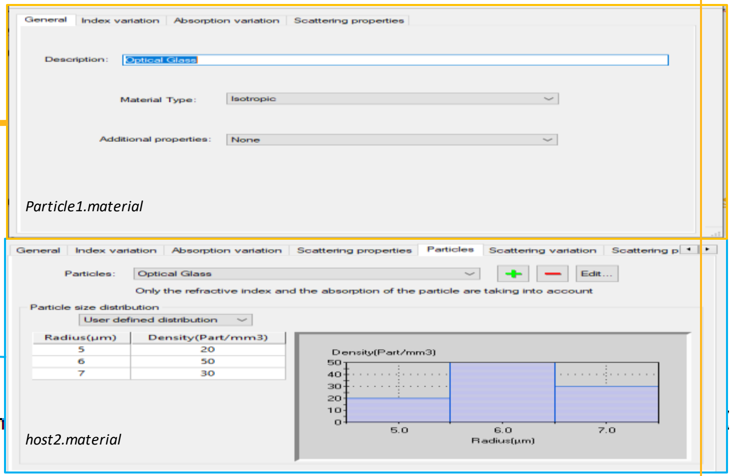
- Advantages:
  - Higher accuracy due to theoretical calculations instead of reverse engineering

→ **MIE feature**

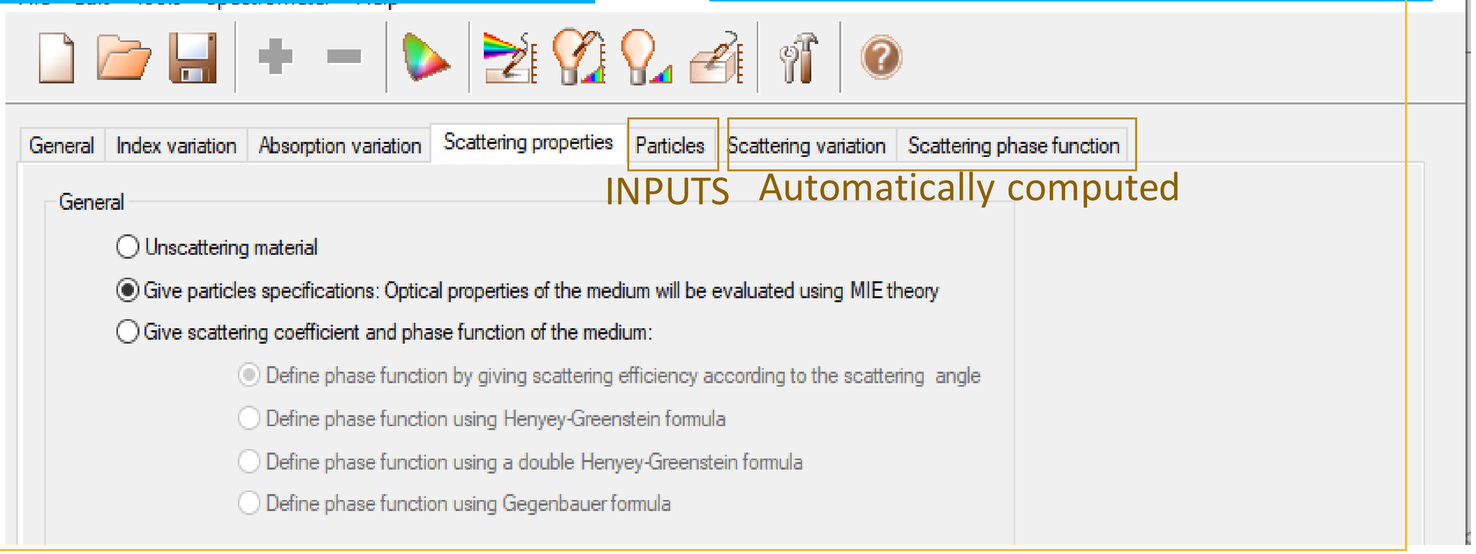
How to use it?

1. Create the particles materials





2. Define the host material
    1. select Mie and the particles



Solution offering

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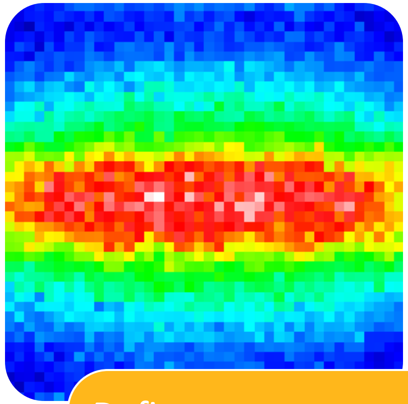
Process

Create Variable Material Modell using Speos

- Inputs:
  - Base Material Properties
  - Particle Property
  - Particle Density



Define common usecase

- Simulate and verify a known material

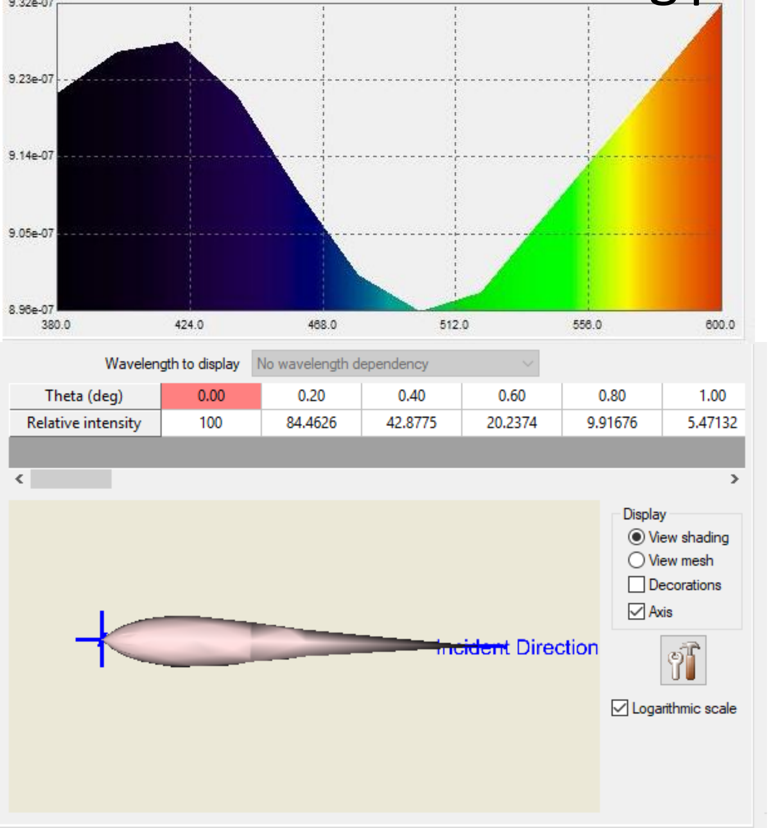
Generate a digital twin

- Vary the Material properties to generate a Digital Twin
- Predict needed Material properties to achieve customer requirement

Material modell

- Needed Inputs:
  - Base Material Properties
    - Wavelength dependant Refractive index(or abbe number)
    - Wavelength dependant absorption coefficient
  - Particle Property
    - Wavelength dependant Refractive index(or abbe number)
    - Wavelength dependant absorption coefficient
    - Particle diameters
  - Particle Density
    - Particle density in Part per mm^3

Wavelength dependant Diffusion coefficient and scattering phase function



Define common use case

- Needed Inputs:
  - Geometry
  - Material thickness
- Optional inputs:
  - Variable pitch
  - Distance between LED Diffus
  - External geometry data (hou
- Output
  - Luminance picture
  - Irradiance on output surface
  - Colorimetry

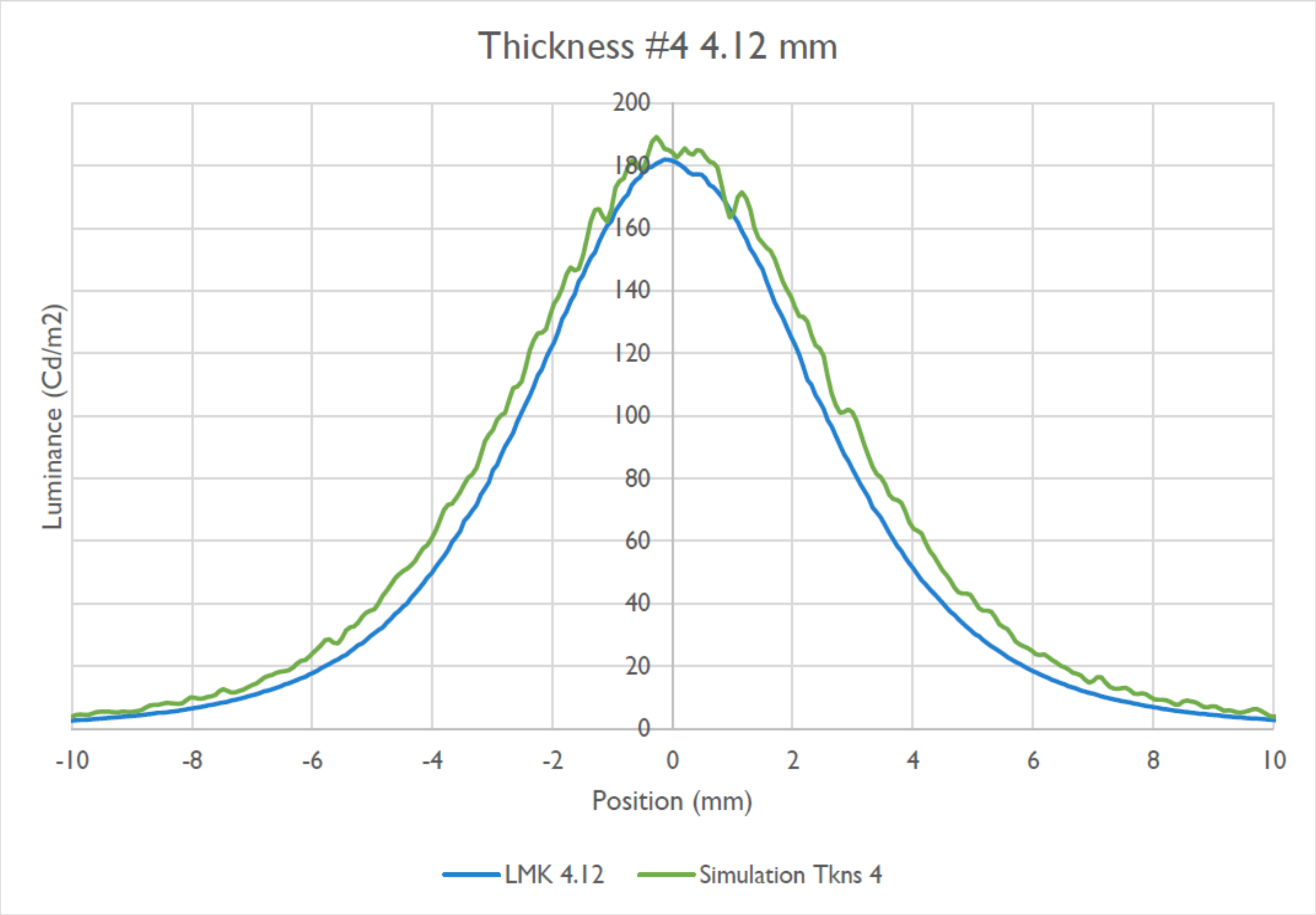
General Idea:

Define the material by ist output not by the Ingridients

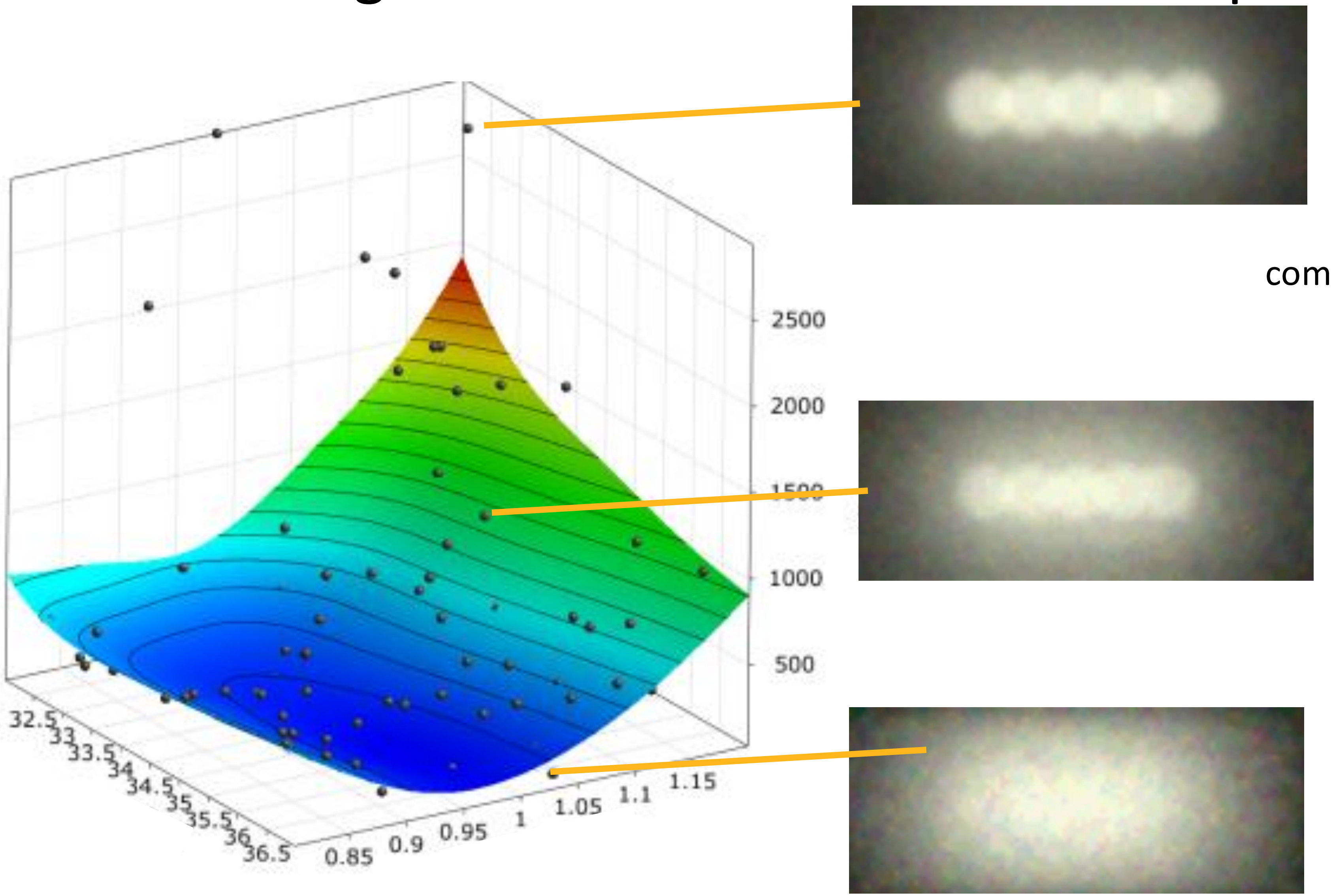
Verify simulation using measurement

- Verify the material Modell using actua measurements to prove the Simulatio/Material modell accurracy

- Ensure High accuracy for the Simulations



Generate a Digital Twin of the material with optiSLang



What is the right combination of material parameters?

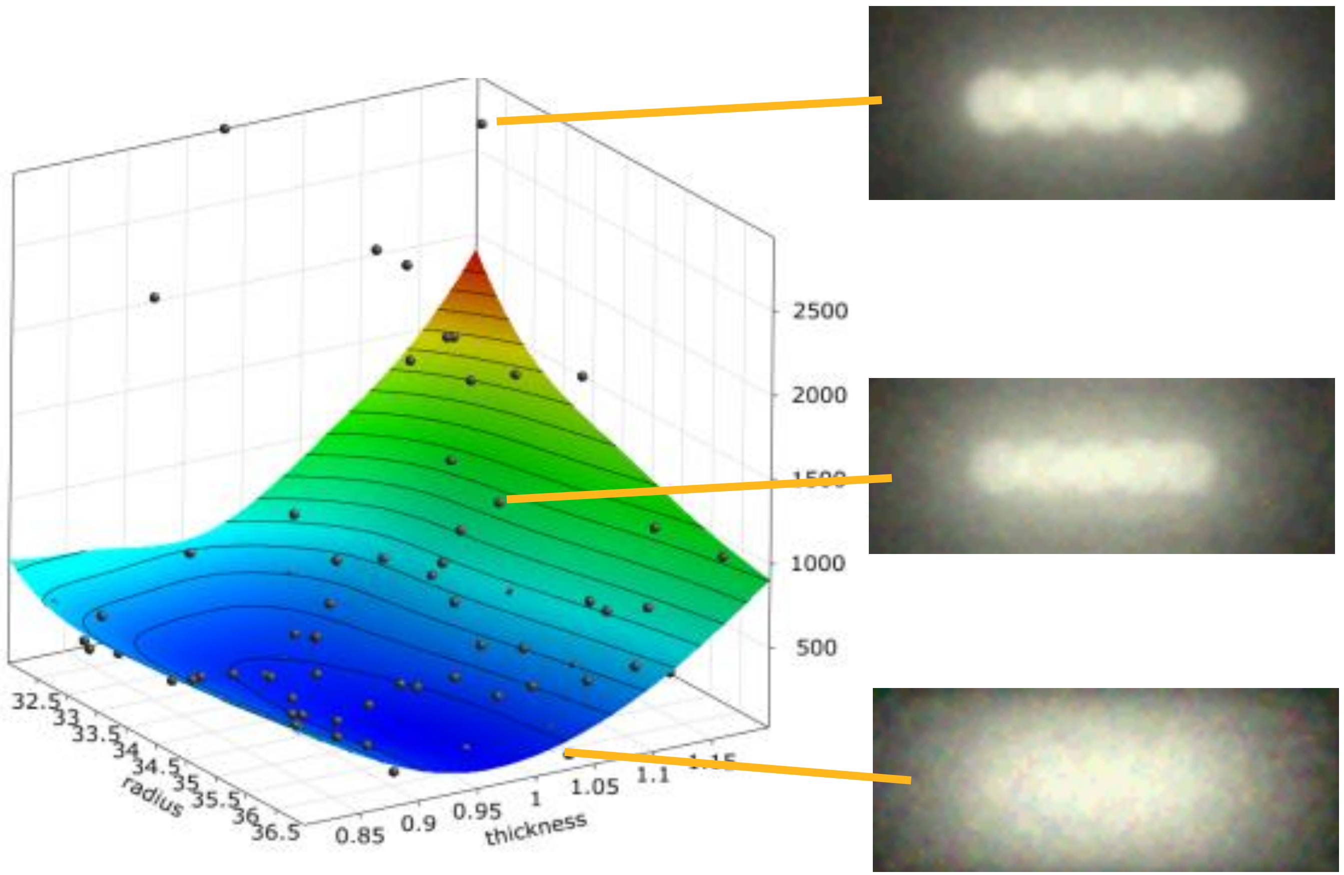
→ **"What – if" scenarios**

→ **Ask the MOP!**

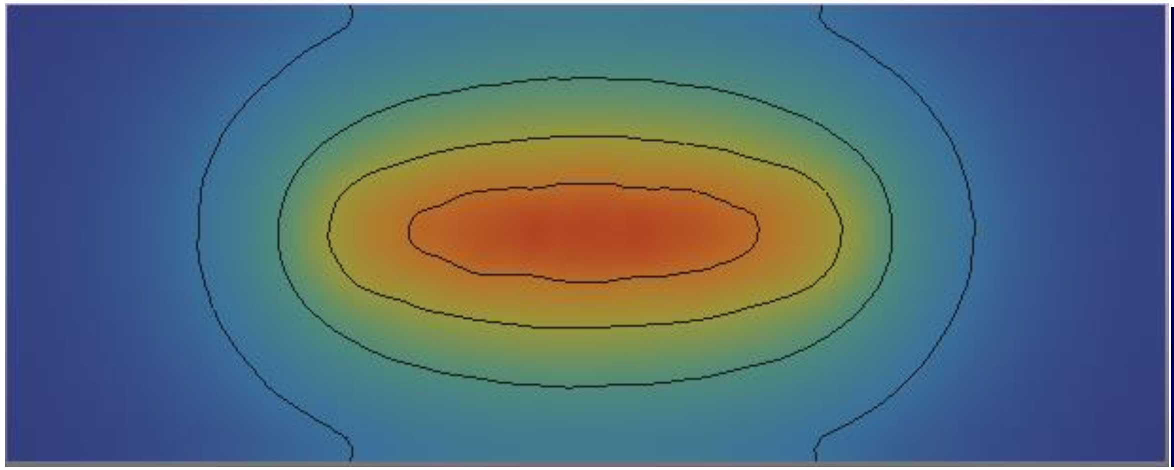
Digital Twin

- The digital twin can be used to find a material based on Outputs:
  - Homogenity
  - Transmission
  - Haze
  - Colorshift

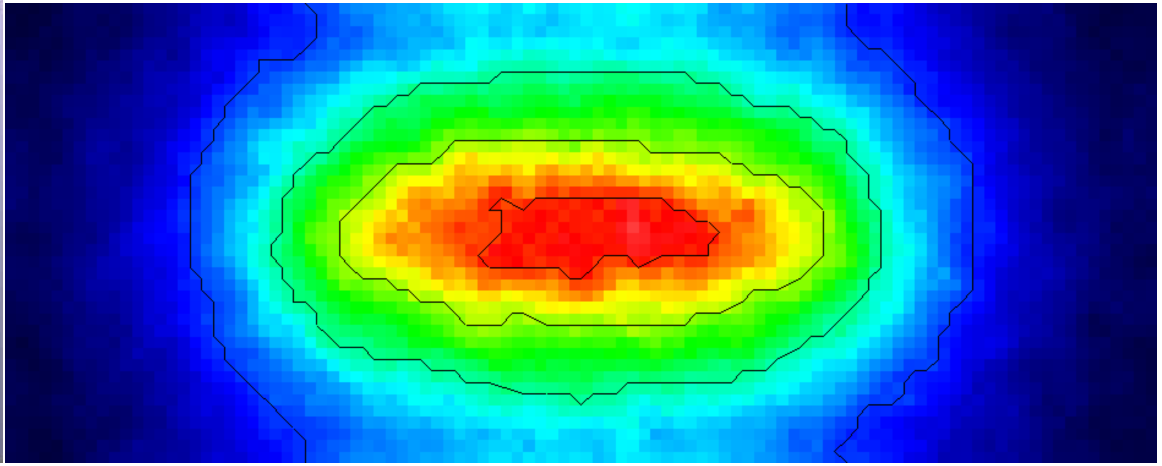
- The digital twin can be used to understand the possibilities and limitation of Material changes



Verify the optimization with simulation



Field Meta Modell



Actual Speos Simulation

Q&A Session

Questions & Contact

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